IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Frank D. D'Amelio, et al.

Serial No.: 09/384,926

Filed: August 26, 1999

For: MEDICAL IMAGING INSTRUMENTS, SYSTEMS AND METHODS

Date: October 12, 2004

Examiner: Y Young Lee

Art Unit: 2613

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Commissioner for Patents
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Marlene Elser
Date of Deposit: October 18, 2004

BRIEF BEFORE THE BOARD OF APPEALS

This is an appeal from a Final Rejection dated April 29, 2004. A Notice of Appeal was received by the Patent Office on August 17, 2004.

Real Party in Interest

The real party in interest is ACMI Corporation.

Related Appeals and Interferences

None

Status of Claims

Claims 1-3, 16-18, 20-22, 24-26, and 35-102 remain in the application.

Claims 24-26 and 35-102 have been withdrawn.

No claims are allowed.

Claims 1-3, 16, 17, and 20-22 stand as being finally rejected under 35 U.S.C. 102(b) as being unpatentable in view of Flagle (3,654,385).

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Claims 1-3,16, 17, and 20-22 stand as being finally rejected under 35 U.S.C. 102(a) as being unpatentable in view of Appellants' admitted prior art

Claim 18 stands as being finally rejected under 35 U.S.C. 103(a) as being unpatentable over Flagle in view of Topper et al (5,157,497).

Claim 18 stands as being finally rejected under 35 U.S.C. 103(a) as being unpatentable over Appellants' admitted prior art in view of Topper et al.

Claims 1-3, 16-18, and 20-22 stand as being finally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 2 of Miller et al (6,100,920).

Status of Amendments

The amendment filed April 21, 2004, has been entered.

Summary of the Invention

This invention relates to medical instruments, systems, and methods and, more particularly, to those that are for use in imaging a site in a medical procedure. There are many optical instruments that are used to generate optical images. In the medical field, endoscopes are used in surgical procedures to generate optical images from within a body cavity. Some endoscopes may have a video camera operatively coupled to a proximal end of the endoscope to receive an optical image and to produce a video signal of that image. The video signal is typically processed by a video signal processor to generate a video output signal. The video output signal is then used to produce an output image displayed by a video monitor, printed by a printing and/or stored by a video storage device. Other endoscopes may have a video sensor integral with the proximal end of the endoscope. The video sensor produces an output that is applied to a video signal processor that processes the video signal to produce a video output signal, which is applied to a video monitor.

Body cavities, hidden or inaccessible spaces, and elongated cavities are either dark or have such low light levels that it is difficult for optical instruments to produce an image that can be satisfactorily imaged by a video camera or video sensor. To overcome such difficulties, a wide variety of light sources have been developed to produce light at levels that provide a sufficient amount of illumination within the body cavity or space. Such illumination enables the optical instrument to produce an optical image of the operative site that can be imaged by the video camera or video sensor. However, current light sources produce uneven illumination resulting in an optical image having differential picture brightness. Differential picture brightness may take different forms. For example, differential picture brightness produces an optical image that is brighter at the center and dim on the periphery or edge, or that has a bright portion toward one side of the picture with decreasing brightness toward the opposite side and a dark or black crescent or portion adjacent the opposite side of the picture.

Differential picture brightness is caused by the light source, which generates a light energy with a peaked characteristic curve with a bright spot in the center and a dim periphery. Each optical instrument reproduces the characteristic curve of the light source resulting in an optical image having differential picture brightness.

The present invention provides compensation for uneven illumination from a light source used to illuminate an interior body cavity or interior body space. As best seen in Fig. 8, the present invention provides a video signal processing apparatus (128) that includes a video signal compensator (130) and a video signal processor (134). The apparatus (128) receives a signal representing an optical image (118) having differential picture brightness. Figure 12(a) is a graphic depiction of such a video signal. The portion of the waveform extending above uniform brightness line (170) represents that part of the optical image that is too bright. Apparatus (128) generates a compensating signal that produces a compensated video signal

depicted by waveform (178) in Fig. 12(b). In Figure 12(b), there is no portion of waveform (178) that extends above uniform brightness line (170).

Video signal compensator (130) includes a one or more sawtooth wave generators and one or more parabolic wave generators. The sawtooth wave generators create sawtooth waveforms having parameters such as a predetermined rising slope, a predetermined falling slope, and a controlled amplitude. The parabolic wave generators create parabolic waveforms having parameters such as a controlled amplitude and orientation. The amplitude and slope of each sawtooth waveform and the amplitude and orientation of each parabolic waveform are adjusted to generate a compensating signal. The compensating signal is produced by adding the sawtooth and parabolic waveforms using an analog signal adder. The compensating signal and the video signal (representing an optical image having differential picture brightness) are added, multiplied, mixed, interpolated, extrapolated, or otherwise applied together to create a compensated video signal that represents an optical image having substantially uniform brightness.

Issues

1. Whether claims 1-3, 16, 17, and 20-22 would have been anticipated by Flagle under 35 U.S.C. 102(b).

2. Whether claims 1-3, 16, 17, and 20-22 would have been anticipated by Appellants' admitted prior art under 35 U.S.C. 102(a).

3. Whether claim 18 would have been obvious in view of the combination of Flagle and Topper et al under 35 U.S.C. 103(a).

4. Whether claim 18 would have been obvious in view of the combination of Appellants' prior art and Topper et al under 35 U.S.C. 103(a).

5. Whether claims 1-3, 16-18, and 20-22 would have been obvious in view of claims 1 and 2 of U.S. Pat. No. 6,100,920 under the judicially created doctrine of obviousness-type double patenting.

Grouping of Claims

Claims 1-3, 16, 17, and 20-22 do not stand or fall together as to the final rejection under 102(b) since each claim recites different limitations.

Claims 1-3, 16, 17, and 20-22 do not stand or fall together as to the final rejection under 35 U.S.C. 102(a) since each claim recites different limitations.

Claim 18 stands alone as to the final rejection under 35 U.S.C. 103(a).

Claims 1-3, 16-18, and 20-22 stand or fall together as to the final rejection under the judicially created doctrine of obviousness-type double patenting.

Arguments

Rejection of Claims 1-3, 16, 17, and 20-22 Under 35 U.S.C. 102(b) In View of Flagle

Independent claim 1 recites an apparatus for compensating an optical image from an endoscope imaged onto a video camera, comprising a device for generating a compensating signal that represents at least one parameter of a compensating waveform, and a logic device coupled to the device and a video signal to add the compensating signal and the video signal to produce an output video signal having its gain both vertically and horizontally compensated to represent an image having a substantially uniform brightness.

Independent claim 16 recites an apparatus for compensating differential picture brightness of an optical image due to uneven illumination from an endoscope imaged onto a video camera, comprising a device for generating a sawtooth waveform having a predetermined rising slope, a predetermined falling slope, and a controlled amplitude; a device for generating a parabola waveform having a controlled amplitude and orientation; and a logic device coupled to the sawtooth waveform device, the parabolic waveform device, and a video signal to produce a

compensating signal that is added to the video signal and used as input to a video signal processor to adjust the gain both vertically and horizontally by increasing the gain representing that part of the optical image from the endoscope that is less bright than a reference and reducing the gain representing that part of the optical image from the endoscope that is brighter than a reference so that the video signal represents an optical image having a substantially uniform brightness.

Independent claim 20 recites a video signal compensator for compensating differential picture brightness of an optical image from an endoscope imaged onto a video sensor, comprising means for generating a compensating signal that represents at least one parameter of a compensating waveform; and an adding means coupled to the compensating signal generating means and a video signal for adding the compensating signal and video signal to produce a compensating video signal that is applied to an input to a video signal processor and having its gain compensated both vertically and horizontally by increasing the gain representing that part of the optical image from the endoscope that is less bright than a reference and reducing the gain representing that part of the optical image from the endoscope that is brighter than a reference and compensating the video signal to represent an optical image having substantially uniform brightness.

Flagle is directed to a color television system that includes a shading circuit to correct shading of a picture area. The problem of shading in color television systems may be caused by loss of balance of color between areas of the television system. Shading may be corrected by adding special waveforms to video signals representing each color field of red, green, and blue (R, G, B). Flagle does utilize horizontal and vertical waveforms and parabolic waveforms. However, Flagle uses such waveforms to adjust each R, G, B color field. Flagle utilizes a vidicon shading circuit 83 that receives signals from a deflection drive circuit and from vertical and horizontal drive circuits 71 and 72, which receive outputs from vertical and horizontal

oscillators 66 and 67. The output of the vertical and horizontal drive circuits 71 and 72 is applied to the deflection drive circuit that is associated with a deflection yoke (not shown) of the camera tube 17 to scan the camera tube electron beam to generate the R, G, B signals appearing at the target electrode 34. The vertical drive circuit 71 and horizontal drive circuit 72 are applied to a blanking adder 73 to blank the electron beam of the camera tube 17 during vertical and horizontal retrace. Therefore, the shading circuit of Flagle compensates for the variations in the operating characteristics of the vidicon tube itself. In other words, the sawtooth wave generator and parabolic wave generator are used to generate a compensating signal to correct deficiencies introduced into or added into the video signal by the vidicon tube itself.

In contrast, the present invention provides a device that receives an optical image from an endoscope. The optical image is in the form of an input video signal that is received by a video signal processing apparatus 128. The video signal processing apparatus includes a video signal compensator 130 and a video signal processor 134. The video signal compensator 130 generates a compensating signal that corrects or compensates for deficiencies of a light source used to illuminate a surgical site. Flagle uses the shading circuit to correct deficiencies of operating characteristics of the vidicon tube.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). As discussed above it is seen that the shading circuit 83 of Flagle compensates for the variations in the operating characteristics of the vidicon tube itself. The sawtooth wave generator and parabolic wave generator of Flagle are used to generate a compensating signal to correct deficiencies introduced into or added into the video signal by the vidicon tube itself. The vidicon shading circuit 83 of Flagle does not correct for differential picture brightness of an optical image

due to uneven illumination from an optical instrument imaged onto a vidicon tube or sensor as required by independent claims 1, 16, and 20.

Claim 2 depends from claim 1 and recites that the compensating signal device further includes a device for generating a sawtooth waveform having a predetermined rising slope, a predetermined falling slope, and a controlled amplitude; and a device for generating a parabola waveform having a controlled amplitude and orientation. Flagle does disclose the use of sawtooth and parabolic waveforms to correct shading. However, as discussed above, Flagle does not disclose a device for generating such waveforms as claimed. Further, Flagle only discusses horizontal and vertical sawtooth and parabolic waveforms of either polarity with adjustable amplitudes for addition to the R, G, B field signals. Flagle does not disclose a device that generates a sawtooth waveform having a predetermined rising slope or predetermined falling slope. Therefore, Flagle fails to disclose the structure recited in claim 2.

Claim 3 depends from claim 2 and recites an adder operatively coupled to and adding said sawtooth waveform device, said parabolic waveform device and a video signal to produce a compensating signal which is applied to an adder together with a video signal used as an input to a video signal processor adjusting its gain both vertically and horizontally by increasing the gain of the video signal representing that part of the optical image which is less bright relative to a reference and reducing the gain of the video signal representing that part of the optical image which is brighter than a reference and wherein said video signal representing an optical image having a substantially uniform brightness. Flagle does not disclose an adder to perform this recited function. Rather, the correction signals produced in Flagle are added to the R, G, B field signals at the video amplifier 40 (see column 4, lines73-75). Thus, Flagle fails to disclose an adder as recited in claim 3.

Claim 17 depends from claim 16 and recites a control device operatively coupled to said logic device to increase the brightness of the compensating signal to a level which is greater

than the average of the differential brightness of the optical image due to the uneven illumination. The Examiner has not pointed out specifically where Flagle discloses such a control device. As pointed out above, Flagle does not disclose a logic device as claimed. Flagle does not disclose a control device coupled to a logic device to add the waveforms to the video signal to adjust the gain thereof as claimed. Thus, claim 17 is not disclosed or taught by Flagle.

Claim 21 recites that the compensating signal generating means further comprises a sawtooth wave generator for generating a sawtooth waveform having a predetermined rising slope, a predetermined falling slope and controlled amplitude; a parabola wave generator for generating a parabola waveform having a controlled amplitude and orientation; and an analog signal adder operatively coupled to the sawtooth wave generator and the parabolic wave generator to add the sawtooth waveform and the parabolic waveform to produce a compensating signal. The deficiencies of Flagle have been discussed above and are equally applicable here. Therefore, the recitation of claim 21 is not disclosed or taught by Flagle.

Claim 22 recites a control device operatively coupled to the adding means to increase the brightness of the output video signal to a level that is greater than the average of the differential brightness of the optical image due to the uneven illumination. Again, the deficiencies of Flagle are pointed out above. Furthermore, Flagle does not disclose or discuss an adding means that increases brightness of the output video signal to a level greater than the average of the differential brightness of the optical image due to the uneven illumination. Therefore, claim 22 is not disclosed or taught by Flagle.

Rejection of Claims 1-3, 16, 17, and 20-22 Under 35 U.S.C. 102(a) In View of Appellants' Admitted Prior Art.

The recitation of claims 1-3, 16, 17, and 20-22 have been discussed above. Additionally, Flagle represents the type of prior art discussed in the Background section of this application and the deficiencies of Flagle represent the deficiencies of such prior art.

Pages 2-4 of Appellants' application describe the problems associated with prior art optical instruments used to generate optical images and especially those optical instruments utilized with medical instruments such as endoscopes. The problem with such devices, as most clearly described on page 4 of Appellants' application, is that when an optical instrument is used in combination with a light guide or distally located illumination source, the resulting optical image from the optical instrument has differential picture brightness due to uneven illumination at the distal end thereof. The last paragraph of page 4 describes that one failed attempt to overcome this problem included modifying the structure and characteristics of the light guide, the optical image transferring system or member or modify both. Page 5 of this application describes that the primary cause for the differential picture brightness is the light source and that unsuccessful attempts have been made to design or modify the light source to reduce or eliminate the above described deficiencies. Pages 5-7 describe that, in addition to the problems of differential picture brightness, some prior art devices introduce shading into a video signal to vary operating characteristics of a video sensor or video camera that generate the video signals representing optical images. Applicants identify specific prior art devices and further point out that these devices are directed to correction of shading associated with inherent deficiencies in either or both the imaging performance of video cameras or sensors. However, none of the described prior art discuss correcting differential picture brightness of an optical image by providing a device that generates a compensating signal and a logic device for adding the

compensating signal to a video signal that represents an optical image having differential picture brightness as claimed.

Therefore, the prior art discussed in the Background section of this application does not teach or disclose the invention recited in claims 1-3, 16, 17, and 20-22.

~~Rejection of Claim 18 Under 35 U.S.C. 103(a) In View of Flagle and Topper et al~~

Claim 18 depends from claim 16 and further recites a video driver amplifier operatively coupled to the logic device to apply the compensating signal to the video signal processor at a low impedance.

The Examiner states that Flagle discloses a device as claimed except for an amplifier and that Topper et al discloses a video driver amplifier 200 operatively coupled to an adder 50. The Examiner then discusses modifying the analog system of Flagle to be upgraded as a digital apparatus by simply utilizing an A/D converter to convert the camera output to include the same digital camera means and competitive processing equipment as specified in claim 8. The deficiencies of Flagle are discussed above and are equally applicable here. Topper et al is discussed on page 9 of Appellants' application as being directed to detecting and compensating for white shading errors in a digitized video signal using a flat white calibration target. However, the amplifier 200 of Topper et al receives intensity information from sensors 530 and provides an output that is converted to digital signals by an analog to digital converter 220. Adders 50 and 60 of Topper et al address correction of particular pixels. As described in column 8, lines 44-50 of Topper et al the adder 50 of Topper et al outputs the appropriate gain coefficient in the horizontal and vertical direction at the timing corresponding to the image location of a particular pixel to be corrected.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to

combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). The Examiner has not indicated where in either Flagle or Topper et al there exists any suggestion or motivation to combine their teachings in order to arrive at the claimed subject matter. Applicants respectfully submit that there is no suggestion or motivation to combine the teachings of Flagle and Topper et al. Appellants' further submit that there is no reasonable expectation of success of arriving at the claimed subject matter by combining Flagle and Topper et al since the combination would not result in an apparatus for compensating differential picture brightness of an optical image due to uneven illumination from an endoscope imaged onto a video camera (claims 1 and 16) or onto a video sensor (claim 20). Finally, the combination of Flagle and Topper et al do not teach or suggest all the claim limitations since neither Flagle nor Topper et al disclose an apparatus for compensating differential picture brightness of an optical image due to uneven illumination from an endoscope imaged onto a video camera (claims 1 and 16) or onto a video sensor (claim 20).

Thus, the combination of Topper et al with Flagle would not produce an apparatus for compensating differential picture brightness of an optical image due to uneven illumination by utilizing a video driver amplifier operatively coupled to the logic device to apply the compensating signal to the video signal processor at a low impedance.

Rejection of Claim 18 Under 35 U.S.C. 103(a) In View of Appellants' admitted prior art in view of Topper et al.

The recitation of claim 18 has been discussed above. Additionally, Flagle represents the type of prior art discussed in the Background section of this application and the deficiencies of Flagle represent the deficiencies of such prior art. Additionally, the deficiencies of the prior art discussed in the Background section of this application is equally applicable here. Therefore, claim 18 is not taught or disclosed by the disclosed prior art.

Rejection of Claims 1-3, 16-18, and 20-22 Under the Judicially Created Doctrine of Obviousness-Type Double Patenting In View of Claims 1 and 2 of Miller et al.

A timely filed terminal disclaimer in compliance with 37 C.F.R. 1.321(c) will be filed to overcome this rejection upon allowance of the claims.

CONCLUSION

For all reasons set forth above, the Board is respectfully requested to reverse the Examiner's final rejection of claims 1-3, 16-18, and 20-22, and confirm patentability thereof.

Respectfully submitted,

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APPENDIX A TO APPEAL BRIEF

Listing of Claims:

1. (Original) An apparatus for compensating differential picture brightness of an optical image due to uneven illumination from an endoscope imaged onto a video camera comprising

a device for generating a compensating signal substantially representing at least one parameter of a compensating waveform required for the differential picture brightness of an optical image to produce a video signal representing an optical image having a substantially uniform brightness; and

a logic device operatively coupled to said compensating signal generating device and a video signal for adding the compensating signal and the video signal to produce an output video signal having its gain both vertically and horizontally compensated to represent an image having a substantially uniform brightness.

2. (Original) The apparatus of Claim 1 wherein said compensating signal device further includes a device for generating a sawtooth waveform having a predetermined rising slope, a predetermined falling slope and a controlled amplitude; and a device for generating a parabola waveform having a controlled amplitude and orientation.

3. (Original) The apparatus of Claim 2 wherein said logic device further includes

an adder operatively coupled to and adding said sawtooth waveform device, said parabolic waveform device and a video signal to produce a compensating signal which is applied to an adder together with a video signal used as an input to a video signal

processor adjusting its gain both vertically and horizontally by increasing the gain of the video signal representing that part of the optical image which is less bright relative to a reference and reducing the gain of the video signal representing that part of the optical image which is brighter than a reference and wherein said video signal representing an optical image having a substantially uniform brightness.

16. (Original) An apparatus for compensating differential picture brightness of an optical image due to uneven illumination from an endoscope imaged onto a video camera comprising

a device for generating a sawtooth waveform having a predetermined rising slope, a predetermined falling slope and a controlled amplitude;

a device for generating a parabola waveform having a controlled amplitude and orientation; and

a logic device operatively coupled to and adding said sawtooth waveform device, said parabolic waveform device and a video signal to produce a compensating signal which, is applied to an adder together with a video signal used as an input to a video signal processor adjusting its gain both vertically and horizontally by increasing the gain of the video signal representing that part of the optical image which is less bright relative to a reference and reducing the gain of the video signal representing that part of the optical image which is brighter than a reference and wherein said video signal representing an optical image having a substantially uniform brightness.

17. (Original) The apparatus of claim 16 further comprising a control device operatively coupled to said logic device to increase the brightness of the compensating signal to a level which is greater than the average of the differential brightness of the optical image due to the uneven illumination.

18. (Original) The Apparatus of claim 16 further including a video driver amplifier operatively coupled to said logic device to apply the compensating signal to the video signal processor at a low impedance.

20. (previously presented) A video signal compensator for compensating for differential picture brightness of an optical image due to uneven illumination from an endoscope imaged onto a video sensor comprising

means for generating a compensating signal substantially representing at least one parameter of a compensating waveform required for the differential picture brightness of an optical image from the endoscope to produce a video signal representing an optical image having a substantially uniform brightness; and

adding means operatively coupled to said compensating signal generating means and a video signal for adding the compensating signal and the video signal to produce a compensating video signal which is applied to an input to video signal processor having its gain both vertically and horizontally compensated by increasing the gain of the video signal representing that part of the optical image from an endoscope which is less bright than a reference and reducing the gain of the video signal representing that part of the optical image from the endoscope which is brighter than a reference and compensating said video signal to represent an optical image having a substantially uniform brightness.

21. (Original) The video signal compensator of claim 20 wherein said compensating signal generating means further comprising

a sawtooth wave generator for generating a sawtooth waveform having a predetermined rising slope, a predetermined falling slope and controlled amplitude;

a parabola wave generator for generating a parabola waveform having a controlled amplitude and orientation; and

an analog signal adder operatively coupled to said sawtooth wave generator and

said parabolic wave generator to add the sawtooth waveform and the parabolic waveform to produce a compensating signal.

22. (Original) The video signal compensator of claim 20 further comprising a control device operatively coupled to said adding means to increase the brightness of the output video signal to a level which is greater than the average of the differential brightness of the optical image due to the uneven illumination.